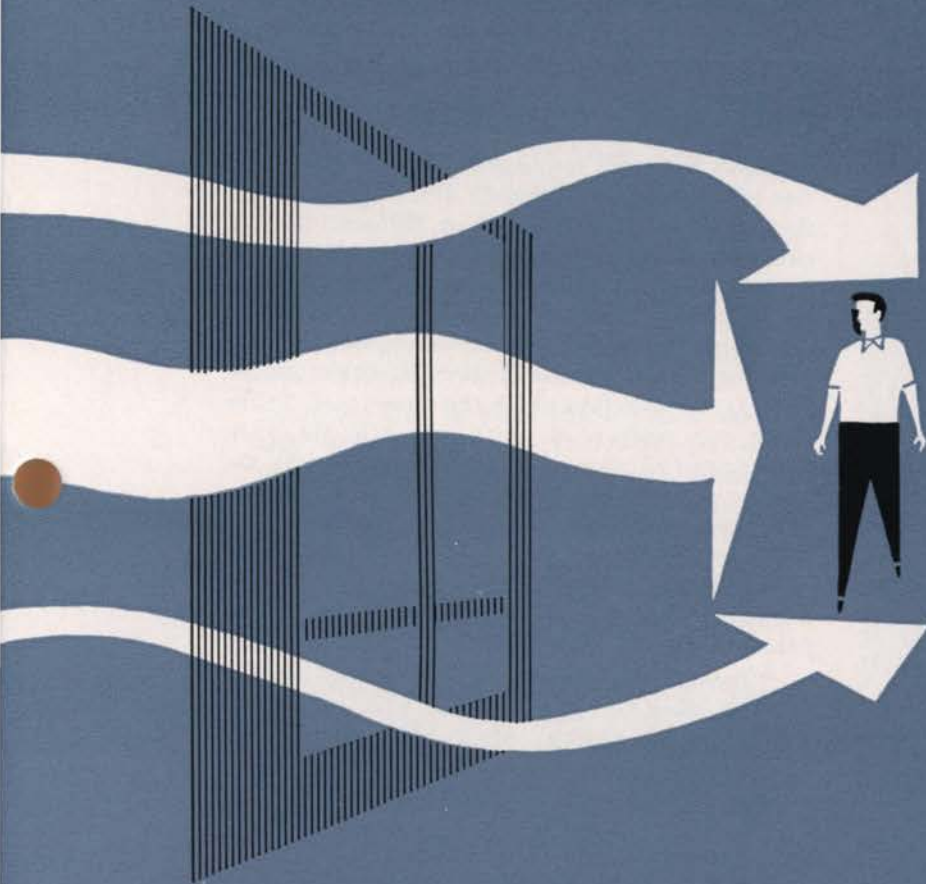


CIRCULAR SERIES

INDEX
NUMBER **F11.0**

WINDOW

PLANNING PRINCIPLES



ISSUED BY THE SMALL HOMES COUNCIL

UNIVERSITY OF ILLINOIS BULLETIN

VOLUME 52, NUMBER 8, SEPTEMBER, 1954. Published seven times each month by the University of Illinois. Entered as second-class matter December 11, 1912, at the post office at Urbana, Illinois, under the Act of August 24, 1912. Office of Publication, 207 Administration Building, Urbana, Illinois.

COPYRIGHT, 1954, BY THE UNIVERSITY OF ILLINOIS. All rights reserved. No part of this circular may be reproduced in any form without permission in writing from the Publisher.

This circular is one of a series on small homes. Other circulars are available for 10c each. For information, write to Small Homes Council, Mumford House, University of Illinois, Urbana.

MATERIAL IN THIS CIRCULAR BY W. H. LEWIS, A.I.A.

Consultants: R. A. Jones, W. H. Kapple, J. T. Lendrum

Editor: M. H. Kennedy

Illustrator: J. J. Sorbie

WINDOW PLANNING PRINCIPLES
SMALL HOMES COUNCIL

F11.0

CONSIDERATIONS IN PLANNING FOR WINDOWS

Windows affect the comfort of the family, both physically and psychologically. They are, moreover, a very important influence on the design and the structure of the house.

From a physical aspect, windows are expected to admit daylight in desired quantities and to provide a means of ventilation. At the same time, cold air leakage around window openings in winter and heat gain through glass in summer* must be minimized.

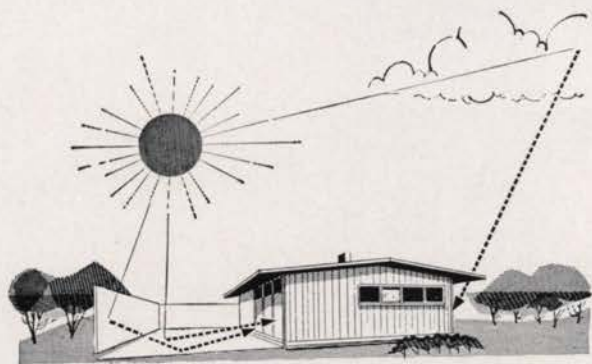
From a psychological aspect, windows are expected to provide an outward view, but with necessary provisions for privacy.

Windows should be acceptable in architectural appearance, both on the inside and the outside of the house. They should, moreover, be of such measurements that they can be used efficiently with other building materials.

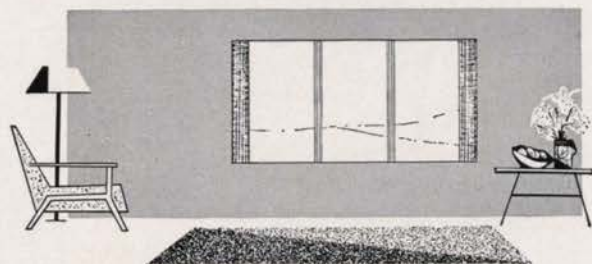
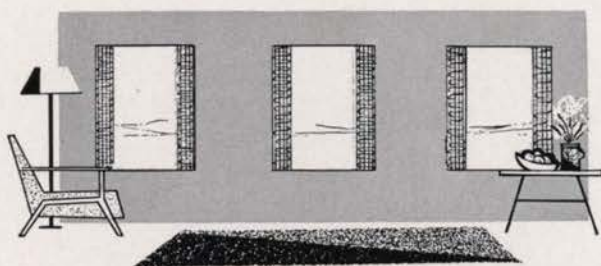
Selection of the types and sizes of windows and their placement depend on how the various windows are to be used.* These requirements frequently are at cross purposes; for example, the placement and size of a window for maximum daylight may not coincide with placement and size for maximum ventilation or for enjoyment of a view. A compromise can be reached, however, by careful planning.

This circular† sets forth principles for selection and placement of windows from the standpoints of daylight, ventilation, view, and appearance.

WINDOWS FOR DAYLIGHT AND SUNLIGHT



Windows admit light from the sun and the sky, including reflected light.



If one large opening is provided instead of several small ones, a more desirable distribution of light is secured. Dark areas between openings are eliminated.

Windows have one common function — the admission of sunlight and daylight (all the light from the sky including that reflected or diffused through clouds).

Uniformity of daylight across an entire room is the objective. Dark corners and high brightness contrasts are undesirable in any room. Factors affecting the distribution of daylight within a room are: 1) the direction which the room faces; 2) the shape and position of the windows in the wall; 3) the type of glass used in the windows; 4) the amount of light reflected by the ceiling, walls, floor, and furnishings; and 5) the type of sunlight controls used inside and outside of the house.

To insure even distribution of the greatest amount of daylight within a room, the following practices are recommended:

- Provide glass areas in excess of 20 per cent of the floor area of each room. This is a general rule-of-thumb. Most building codes recommend that the glass area be not less than 10 per cent, but much more is desirable to meet daylight requirements on cloudy days. On brighter days, the amount of light can be controlled by interior and exterior shading devices.
- Place principal window areas toward the south except in warm climates where a northern orientation is favored in order to limit heat from the sun. The south sky is considerably brighter than the north sky. A southern exposure permits the maximum amount of daylight and also the greatest amount of solar heat in winter. Direct sunlight can also be controlled more easily on the south than on the east and west early and late in the day.
- Group window openings in the wall to eliminate undesirable contrasts in brightness.

* See also Small Homes Council circulars: G6.0, "Summer Comfort," and F11.2, "Insulating-windows and Screens"; F11.1, "Selecting Windows."
† Publication results from a research investigation on windows made by the Small Homes Council under a grant given to the University of Illinois by the Lumber Dealers Research Council.

Provide one large opening on a wall instead of several small ones to do away with dark areas between openings.

- Use windows in more than one wall for greater admission and better distribution of daylight.

- Select the window shape that gives the desired distribution of light within each room. For a broad, shallow distribution of light, use short, wide windows. Tall, narrow windows give a thin, deep distribution of light. Intensity of light is great near the window and then drops off rapidly and smoothly within a short distance.

- Place the window as high in the wall as possible to lengthen the depth of light penetration into the room. If possible, place the head of the window close to the ceiling. More sky is visible through the upper part of the window than the lower; moreover, the overhead sky is brighter than the sky at the horizon.

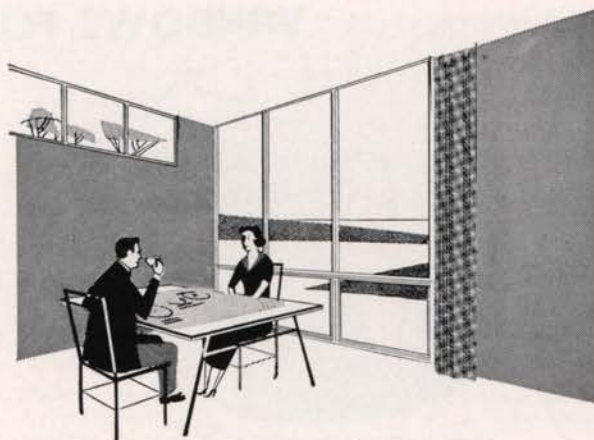
- Do not specify corner windows or bay-windows as a means to increase the daylight effectiveness of the window. The actual area of glass is greater and more costly than the effective daylight area obtained.

- Use the kind of glass which is most suitable for room purposes. Use clear sheet or polished plate glass for unobstructed vision; translucent glass for privacy since it diffuses images. Special types of glass which reduce glare and heat from the sun are available at higher cost. Glass is the most durable and least expensive transparent material for use in windows.

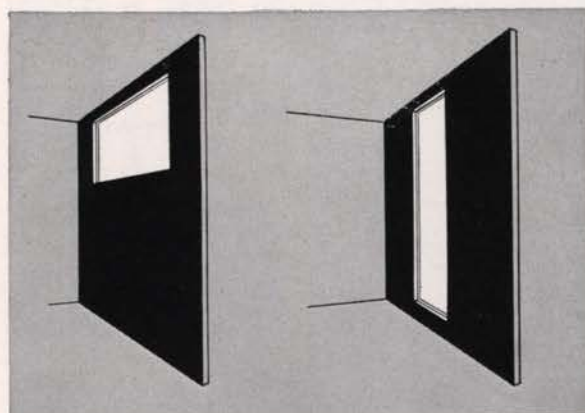
- Screen only those parts of the window that open for ventilation. Full screens on a double-hung window can absorb as much as 50 per cent of the available daylight; half screens absorb only 15 per cent. Painting screens will reduce the daylight more.*

- Finish ceilings and walls (and even the floor) in light colors to take advantage of light distribution made possible by reflection. Use flat or dull finishes. Furnishings, especially draperies, should also be light in color.

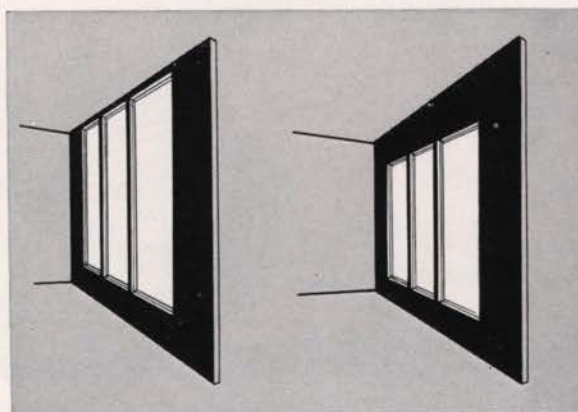
- Mount draperies, curtains, shades and other window hangings above the head of the window and to the side of the window frame in order to free the entire glass area and thus admit the greatest amount of light. Dark, heavy draperies hung over the sides and top of a window can reduce the available daylight by 75 per cent.* The practice of pulling window shades one-fourth or one-half of the way down results in loss of light at the rear of the room where it is most needed.



Windows in more than one wall give more effective daylighting than windows in just one wall.



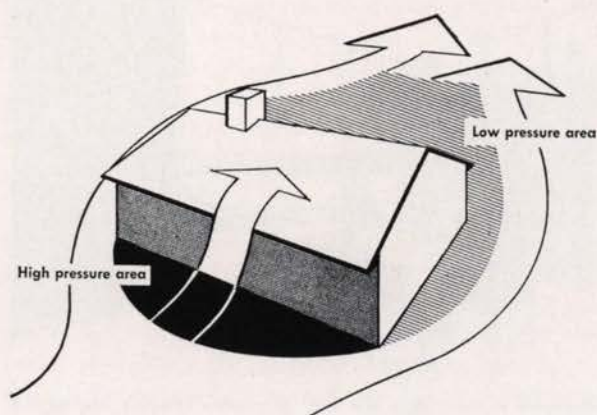
A horizontal window gives a wider spread of light than a vertical window of the same area.



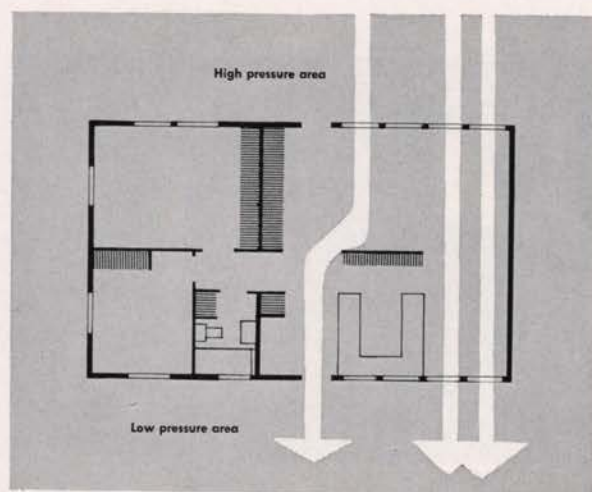
The higher the window is placed in the wall, the deeper is the penetration of light.

* Based on research findings of the University of Michigan Engineering Research Institute, Ann Arbor, Michigan.

WINDOWS FOR VENTILATION



A high pressure area is created when air strikes a building. Low pressure areas are created as air moves over and around a building.



Air moves through the house because of differences in pressure. Partitions slow down the movement of air and divert its path.

Natural ventilation of a house is primarily a summer problem — one of comfort.

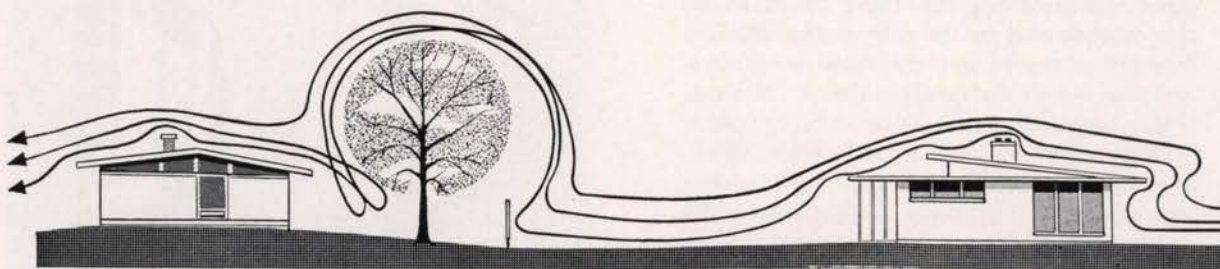
The number, size, and placement of ventilation openings are all important elements in planning windows for ventilation. The effectiveness of windows in achieving desired ventilation depends also on which windows are opened and on how far they are opened.

The difficulty in using a window for both admission of light and air is that its size and location for the best daylighting often conflict with the size and location which produce the best ventilation.

Principles of air movement* as applied to houses are:

1. Air moves because of 1) differences in temperature, or 2) differences in pressure. In one-story houses, the movement of air because of differences in temperature is negligible. The placement of windows in most houses, therefore, should be governed by movement of air due to pressure differences.
2. A high pressure area is created when the air strikes a building. Low pressure areas are created as the air moves over and around the building.
3. Air flows into a house through openings in the wall against which the wind blows. The wall acts as a dam, causing the air pressure to build up.
4. Air flows out of a house because of differences in pressure. It moves from high pressure areas inside the house through openings to areas of lower pressure outside the house.
4. To speed movement of air within a room, the openings through which the air leaves the house should be larger than those through which it enters.
5. Obstacles in the path of moving air cause it to change direction, thus slowing it down — i.e., trees, shrubbery or fences on the outside; partitions, walls or furniture on the inside. Because the cooling effect of air in summer depends on its speed,

* Based on research findings of the Texas Engineering Experiment Station at College Station, Texas.



Obstacles in the path of moving air slow it down and divert its flow away from the windows. Full advantage of breeze is obtained when there are no obstructions.

obstructions which slow the movement of air should be held to a minimum.

The angle at which the air enters and leaves the room is the controlling influence on the pattern of air movement within the house. This angle depends on the location and type of window.

Use the following recommendations as a guide in selecting and locating windows for ventilation:

- **Provide ventilation openings in excess of 10 per cent of the floor area of a room.** This is a general rule-of-thumb. Most building codes have established minimums of 4 to 5 per cent of the floor area, but just as large glass areas provide daylight for cloudy days, sufficient ventilation openings can offer relief on warm, sultry ones.
- **Locate the house and the ventilation openings to take full advantage of prevailing breezes.** Do this by determining the high and low pressure areas as defined by the shape of the house — the walls which the breeze will strike and the walls around which the air moves. Allow for changing wind directions.
- **Locate windows so as to effect the best movement of air 1) across the room, and 2) within the level that occupants sit and stand.** Do this by 1) placing windows away from exterior corners, and 2) placing double-hung, horizontal sliding, casements and awning windows in the lower part of the wall since such windows cannot direct the movement of air downward.

Window types which can deflect air movement downward (inswinging top-hinged window, jalousie) are not restricted to low placement.

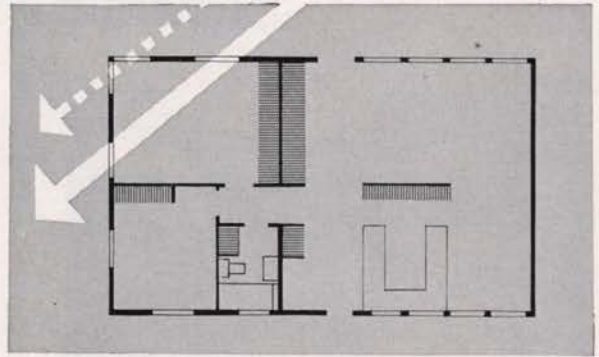
Venetian blinds and similar interior controls help to deflect air movement.

Plan landscaping, interior partitions, and furniture so they do not interfere with air movement. If possible, place the house so that existing buildings and hills do not divert the wind from the house; avoid setting trees, shrubbery and fences in the path of the breeze; plan interior partitions and furnishings so that they do not obstruct air flow within the house.

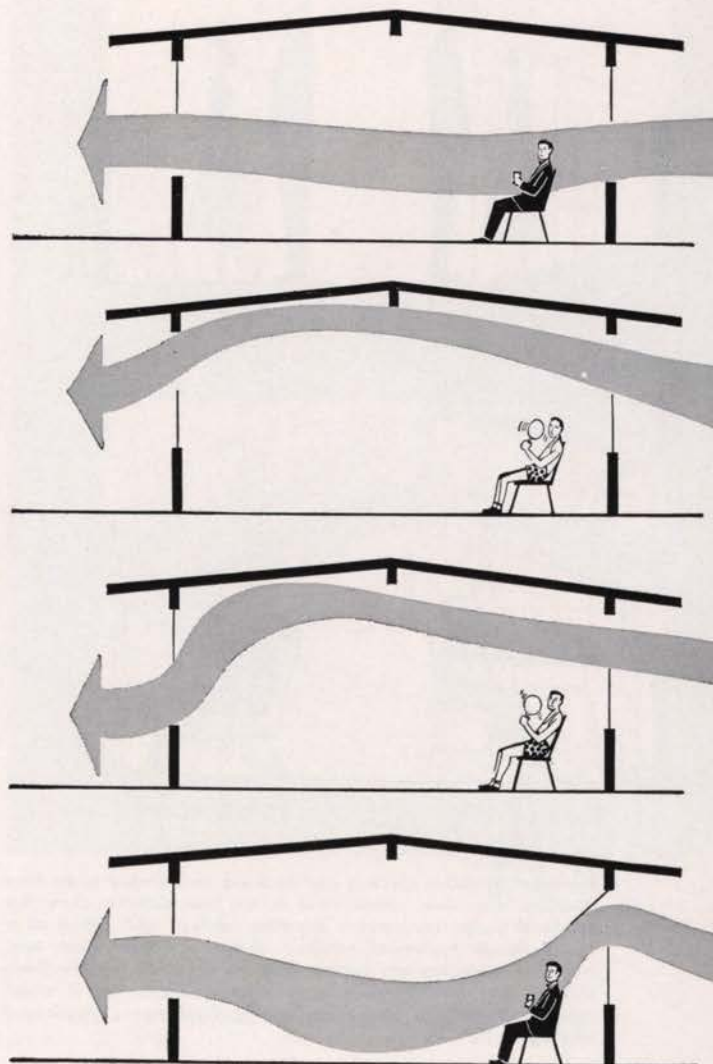
For summer comfort, air should flow across the room at the level of occupancy.

If the location and type of windows are such that they cause the air to flow along the ceiling, the room can be uncomfortable for occupants.

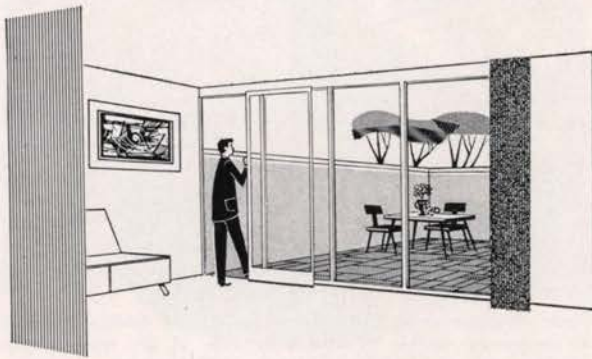
The position of a window in a wall depends on the type of window. Some windows can deflect air downward and do not have to be placed low in the wall.



Place windows away from exterior corners to achieve the best air movement across a room. The flow of air when corner windows are used is indicated by the dotted arrow.



WINDOWS FOR VIEW



Large glass areas can be used to extend indoor space outward. Outdoor living areas thus become an integral part of the house.

Being able to see out through windows is as important to occupants of a house as is the admission of daylight and air.

The outdoor scene which the occupants will view from the house should be considered in the orientation of the house, in the determination of the size of the windows, and in the placement of the windows.

Sometimes the house is placed on a lot to command a picturesque landscape scene; sometimes the homeowner or architect finds it necessary to create a pleasant view to hide a less desirable one — *i.e.*, a planted area to hide an alley. Large glass areas extend indoor space outward, making outdoor living areas an integral part of the house.

Problems in window placement may arise when a house is set on the lot to command a natural view on the east or west since it is difficult to shade the occupants' eyes from the sun early or late in the day. Devices to keep the sun rays away from the windows may obstruct the view. View windows on the south can be protected from the sun rays by a roof overhang; those on the north are not bothered by the sun.

The glare of the sun on an east-west orientation for a view located within the boundaries of a lot is not difficult to control. Fences and tall shrubbery instead of obstructing the view actually define it.

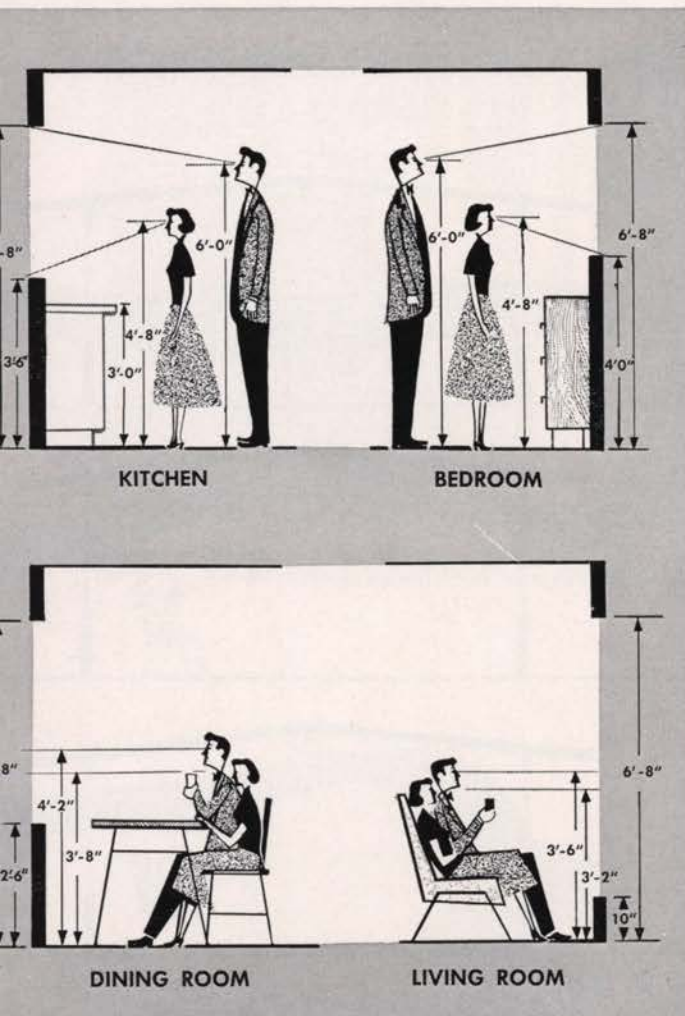
Generally the proportions of the window can be scaled to the view — a horizontal window for a panoramic view, such as a mountain range; a vertical window for a confined view, such as a terrace.

In selecting windows to frame any view, it is important to avoid those having obstructions which interfere with the view. The windows should be placed at carefully determined heights so that the sills and intermediate divisions do not obstruct the line of sight, either that of tall or short adults.

The following recommendations for placement of windows serve as a check list of good practices.

- To minimize obstructions in the line of sight, use fixed glass except in those areas where ventilation must be provided. Screens are not needed on fixed glass and, therefore, eliminate another interference from a standpoint of view. Windows having slight divisions are acceptable. A horizontal division more than 4 inches thick is not desirable when the division falls in the line of sight. Vertical divisions are not as objectionable as horizontal ones.

- Determine sill heights on the basis of room use and furniture arrangement. The illustrations show recommended heights of windows for view.



Horizontal window division members are undesirable when they interfere with view. Dimensions in the four sketches show the eye-level range for persons standing, sitting, and sitting at a table. Avoid horizontal window divisions within these eye-levels. Dimensions are based on a study of 1) persons from 5'-0" to 6'-4" tall; 2) usual window-head heights; and 3) usual window-sill heights as determined by furniture or baseboard heating units.

WINDOWS FOR APPEARANCE

Because of the present-day trend to simplify the exterior appearance of houses by eliminating unnecessary and costly decoration, architectural expression in houses is obtained to a large degree by the relationship of window areas to solid-wall areas. The number and placement of windows, and even the type of window, affect the architectural character of the house.

While windows must first be selected, sized and located to satisfy interior requirements, minor adjustments in size and/or location may be necessary to provide an acceptable appearance on the exterior of the house. Windows should be so used that the house gives an appearance of continuity, rather than one of unrelated glass and wall areas.

PRIVACY

Use of large glass areas usually requires some controls for privacy, both in the daytime and at night.

Obvious controls include draperies and blinds. Consideration must be given to the size and the placement of these hangings so that they do not cancel the benefits of breeze. The use of louvers or other opaque types of ventilating units which do not have to be draped is one solution to this problem of privacy with ventilation. Placing windows high in the wall is another effective means of obtaining privacy, especially in bedrooms.

When views are within the boundaries of the lot, fences or shrubbery may eliminate the need for privacy controls on the interior of the house in the daytime.

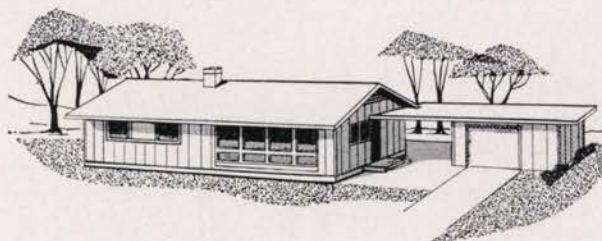
HEAT LOSS AND HEAT GAIN

Window areas are a major source of heat loss in winter and heat gain in summer. This heat loss and heat gain can be reduced: 1) through correct placement of the house on the lot in relation to the sun; 2) through design of the house as regards the amount of glass area and its location in the walls; and 3) through the use of insulating glass.

Heat is lost through glass and through cracks around the sash of operating windows. This loss must be taken into consideration in determining the amount of glass to be used and the design of the heating system. Heat loss may limit the amount of glass in the house, but if insulating-windows are used instead of single-glazed ones, larger glass areas are possible.

The placement of room-heating units (radiators, baseboard units, registers) below windows eliminates cold drafts since the glass and the air around the windows are warmed.

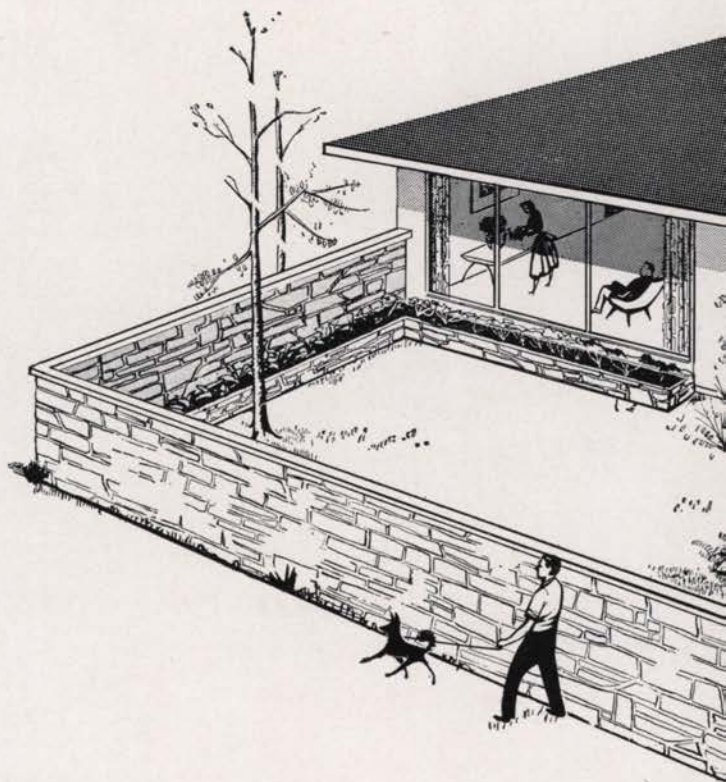
In controlling heat gain, the location of glass areas is more important than the amount of glass. The house should be placed on the lot, and if necessary shaded, so that the rays of the sun can be admitted during the winter when solar heat is desirable, but excluded during the hottest months of the summer.



Windows in this house are sized and placed to form a pleasing relationship between glass and solid wall.



This house is not as pleasing in appearance as the one above due to the number of unrelated glass and wall areas.



Even though the glass area is large, the occupants of the house can have privacy.

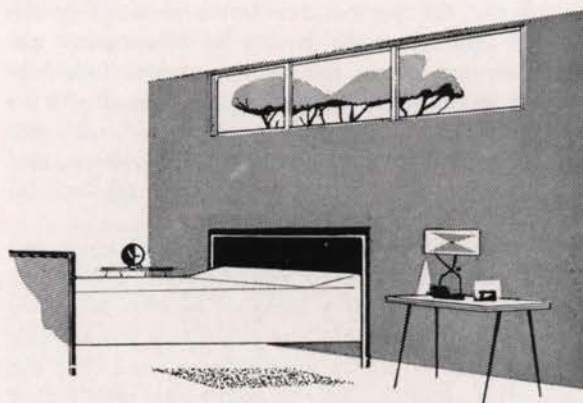
WINDOW DESIGN

In planning for windows, consider the use of large glass areas not only in the living room but in any room of the house that can benefit from increased daylight, view, or heat gain from the sun. On the other hand, small window areas may serve several purposes well. A bedroom on a western exposure, for example, may employ a series of short, high windows that supply daylight, provide privacy, and yet keep the glass area on this exposure to a minimum so that the rays of the sun are not objectionable.

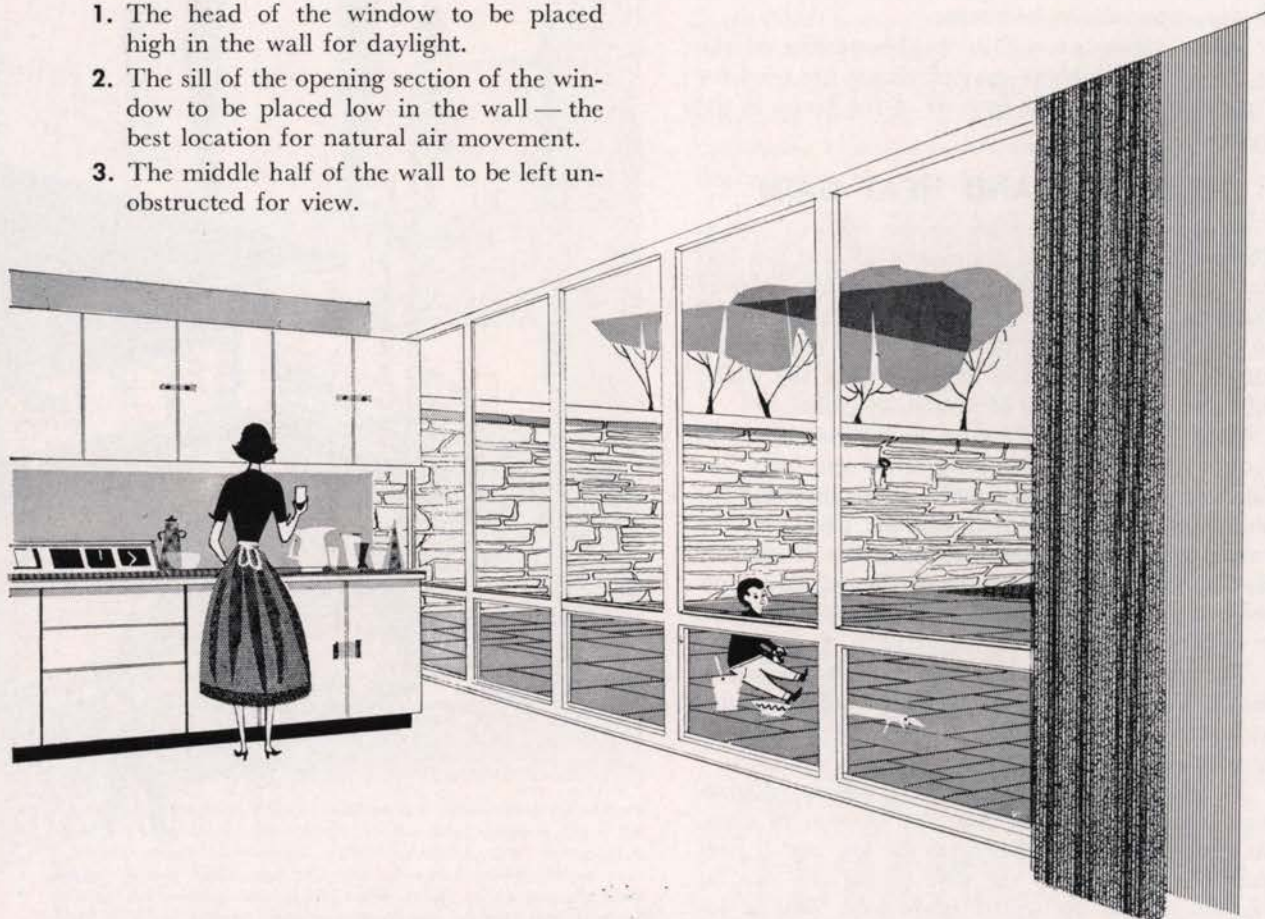
The design of many factory-made window units ("stock" windows) is inconsistent with the requirements for windows as discussed in this circular. Many stock windows are limited in their size and proportions by their mechanical operation; furthermore, intermediate division pieces may interfere with lines of sight. Because of such limitations, custom-made windows are frequently used even though they are often more costly and may be inferior in quality.

Often a combination of window types is best suited for both interior requirements and exterior appearances. The use of fixed glass with one or more operating window units achieves a functional window which also has a pleasing architectural character. Such units permit:

1. The head of the window to be placed high in the wall for daylight.
2. The sill of the opening section of the window to be placed low in the wall — the best location for natural air movement.
3. The middle half of the wall to be left unobstructed for view.



Small windows can serve several purposes well. In this west bedroom, the short, high windows supply daylight, provide privacy, and minimize heat from the sun.



Large windows many times are suitable for rooms other than living areas. Here the window overlooks the play area and permits supervision of children from the kitchen. Use of fixed glass with an operating unit achieves a window which serves the four functions — daylight, ventilation, view, appearance — to best advantage.